M E M O R A N D U M

TO: Kean S. Goh, Ph.D.
Agriculture Program Supervisor IV
Environmental Monitoring Branch

FROM: Juanita Bacey, Environmental Research Scientist

DATE: February 2003

SUBJECT: PRELIMINARY RESULTS OF STUDY #210: BIOLOGICAL ASSESSMENT IN THE SACRAMENTO AND SAN JOAQUIN WATERSHEDS (FALL 2002 THROUGH SPRING 2004)

SCOPE OF THIS MEMORANDUM

The Department of Pesticide Regulation (DPR) conducted bioassessment sampling in tributaries to the Sacramento and San Joaquin Rivers as part of the Surface Water Protection Program. Monitoring for this study is planned to occur in the fall and spring for two consecutive years beginning in 2002. Monitoring data presented here is from the fall of 2002 and spring of 2003. This data includes physical habitat assessments, benthic macroinvertebrate (BMI) metrics, and chemical analysis.

One objective of this project was to establish baseline aquatic biological community structure and physical habitat conditions in wadeable, agriculture and urban dominated surface streams. DPR collaborated with the Central Valley Regional Water Quality Board (CVRWQCB) on this project to assist them with their bioassessment monitoring and data collection needs. CVRWQCB staff are exploring the use of bioassessment as a water quality monitoring tool, with the hope that its future role will be in a more regulatory capacity (R. Holmes, personal communication, 2004). The current use of bioassessment by the CVRWQCB for water quality assessments in the San Joaquin River basin, is supported and used by the Total Maximum Daily Load (TMDL) effort as described in the OP Pesticide TMDL Bioassessment Work Plan (CVRWQCB, 2002a). In the Sacramento River basin, monitoring is conducted under the Surface Water Ambient Monitoring Program (SWAMP) as described in the Region 5 workplan (CVRWQCB, 2002b).

A secondary objective was to enable staff to become familiar with bioassessment equipment and develop effective bioassessment and physical habitat monitoring skills. This pilot project will assist DPR in developing a bioassessment monitoring program within the Surface Water Protection Program so as to better assess the impact of pesticides to surface waters. This memo presents data collected during the first two seasons of sampling. Benthic macroinvertebrate data has been summarized and is presented in biological metrics. An in-depth interpretation of the data will be included in the final report.

BACKGROUND

California has over 200,000 miles of rivers and streams. Bioassessment has been conducted at over 3000 sites throughout the state by various agencies, universities and other entities (Tetra Tech, 2003). The California Department of Water Resources has collected bioassessment data since 1975, while the United States Geologic Survey began its long-term program in 1992 as part of the National Water Quality Assessment Program. The California Department of Fish and Game also began conducting projects in 1992, and has developed standard protocols for bioassessment based on the U.S. EPA Rapid Bioassessment Protocols. The State Water Resources Control Board (SWRCB) and its nine regional boards are responsible for implementing water quality standards for the state of California. They have only recently begun to apply bioassessment practices to their monitoring programs.

Bioassessment is a survey of the physical habitat and biological community of a water body to determine the integrity or current condition. Using the biological community instead of just one species allows for a more comprehensive determination of the health of a water system.

Aquatic BMI populations (such as insects, worms, snails, etc.) are commonly monitored in bioassessment studies because they are ubiquitous, complete the majority of their life cycle in water, and are relatively stationary. They are useful in evaluating the overall health of a water system in flowing waters because they are affected by changes in a stream's chemical and/or physical structure. The variety of species and population sizes present in the creek are reflective of the overall health of that biological community and can be used as water quality indicators (SWRCB, 2001).

Using bioassessment to determine the current condition of a water body will be useful in identifying impaired water bodies. This may also lead to further evaluation of bioassessment as a tool for evaluating management practices and mitigation measures that prevent pesticides from moving offsite.

MATERIALS AND METHODS

Site Description

This project targeted areas of concern, and sites were selected using the following criteria:

- Receives drainage from agriculture or urban runoff
- Has a history of previous pesticide detections
- There is a need for a current condition evaluation

Eight sites were selected, four urban dominated sites in the vicinity of Elk Grove, and four agriculture dominated sites in the vicinity of Stockton, California (Figure 1). Each creek selected had two sampling sites to better assess that stretch of the creek. Each sampling site consists of a 100-m stretch of the creek called a reach. The selected sites were:

<u>Urban (Figure 2)</u>

1. Elder creek at Elk Grove-Florin road
2. Elder creek at Bradshaw road
3. Elk Grove creek at Emerald Vista drive
4. Elk Grove creek at Elk Grove-Florin road

<u>Agricultural (Figure 3)</u>

5. Little John creek at Austin road
6. Little John creek at Stanley road
7. Lone Tree creek at Lone Tree road
8. Lone Tree creek at Escalon-Belota road

Study Plan

Monitoring was conducted in the fall of 2002 and in the spring of 2003 in order to collect information on seasonal variation. Monitoring continued in the fall of 2003 and those results will be reported with the monitoring in the spring of 2004. Because habitat modifications and pesticides can be stressors and indicators of BMI absence; therefore, a physical habitat assessment was completed for each reach, along with the collection of water, sediment and BMI samples. Water samples were analyzed for selected organophosphates (OPs), pyrethroids (PY), and selected triazines (Table 1). Sediment samples were analyzed for pyrethroids. Some of these pesticides had been previously detected in these water systems.

Sampling Method

Physical habitat assessment and BMI sampling followed Standard Operating Procedure (SOP) # FSWA010.00. Each site or reach was selected based on available access, using a non-point source design. This design is used when there is no obvious point of discharge into the stream. Typically, several sampling reaches are selected to better assess the entire stream. If there were any disagreement in determining exact sampling sites or sampling procedures, U.S. EPA guidelines took precedent (U.S. EPA, 2001).

Water monitoring was conducted as described in SOP FSWA002.0 (Bennett, 1997). Water samples were individually collected for each chemical screen. All samples collected were grab samples consisting of a 1-liter amber glass bottle on a grab pole, collected from center channel. The amber bottles were sealed with Teflon-lined lids.

One sediment sample was collected at each site. Sediment samples were collected using a 24-inch long, 2-inch diameter, polycarbonate cylinder tube, and a 4-inch putty knife. One end of the tube was thrust into the sediment and then removed. The top 2 inches of the sediment collected in the tube was placed into a clear 1-pint jar. This was repeated several times, in the same general area, until the jar was at least one-half full.

Water and sediment samples were transported and stored on wet ice or refrigerated at $4^{o}C$ until extraction for chemical analysis, as per SOP QAQC004.01 (Jones, 1999).

Environmental Measurements

Habitat assessment was evaluated following the physical habitat scoring criteria (Figure 4) as described in the California Stream Bioassessment Procedure and also using a modified U.S. EPA Physical Characterization/Water Quality Field Data sheet (Figure 5). This was based on U.S. EPA national standardized methods. One assessment was completed at each reach sampled. In addition, the following was measured at each BMI sampling site: Global Positioning System coordinates of location, riffle length, transect width and depth, velocity, canopy cover, substrate complexity, riffle gradient or slope, water temperature, dissolved oxygen, pH, and conductivity (Figure 5).

Benthic Macroinvertebrate Identification

The California Department of Fish and Game's Aquatic Bioassessment Laboratory performed BMI identification. Quality control was conducted in accordance with previously established DFG procedures. A sub-sample of 500 macroinvertebrates were identified to genera and, when possible, to species.

Pesticide Analysis
The California Department of Food and Agriculture's Center for Analytical Chemistry performed chemical analyses. Quality control was conducted in accordance with SOP QAQC001.00 (Segawa, 1995). Ten percent of the total number of analyses were submitted with field samples as blind spikes. The following was used to determine concentrations of pesticides:

- OPs - GC/FPD - gas chromatography/flame photometric detector
- Pyrethroids - GC/ECD - gas chromatography/electron capture detector
- Pyrethroids (in sediment) – GC/ECD, confirmed with GC/MSD - gas chromatography/mass selective detector.
- Triazines - APCI/LC/MS/MS – atmospheric pressure chemical ionization/liquid chromatography/mass spectrometry
- Comprehensive chemical analytical methods will be provided in the final report. The reporting limit is the lowest concentration of analyte that the method can detect reliably in a matrix blank. Method titles and reporting limits are reported in Table 1.

RESULTS

Environmental Measurements
Most environmental measurements were within normal ranges (Table 2). Temperature ranged from 8.7 to 19.6ºC, with the lowest temperatures occurring in the urban creeks in the fall of 2002 (8.7 to 10.4 ºC). Specific conductance (EC) ranged from 208.1 to 337.8 µS/cm in the urban creeks (spring and fall). In the agriculture dominated creeks EC ranged from 60.1 to 124 µS/cm in the fall to 84.9 to 368.2 µS/cm in the spring. Dissolved oxygen (DO) ranged from 0.23mg/L to 10.4mg/L, with the lowest reading occurring in the urban creeks (0.23 to 2.87 mg/L). This may have been due to the stagnant conditions of the creeks and possible inaccurate readings by the DO meters under these conditions. The physical habitat score can be subjective due to the experience of the individual making the assessment, but in this case, when comparing both fall and spring scores, the scores are relatively close.

Pesticide Concentrations
Pesticide detections were relatively low with the exception of the herbicide diuron (Table 3). The OP diazinon was detected only at Elk Grove Creek (urban) at both sites in the fall and spring (trace to 0.212 µg/L). Chlorpyrifos was detected only at Elder Creek (urban) both seasons (trace to 0.108 µg/L). There were two trace detections of the OP dimethoate at Little John creek (agriculture, both seasons). The herbicide prometon was found in the spring at Elk Grove creek sites (0.131 to 0.133 µg/L), and the herbicide DACT was detected once in the spring at Lone tree creek (agriculture, 0.135 µg/L). The herbicide diuron was detected twice (1 urban and 1 agriculture) in the fall of 2002, 0.174 and 0.063 µg/L respectively.
It was also detected in the spring of 2003 at every site (0.15 to 14.24 µg/L), the highest detections being in the agriculture creeks. There were no pyrethroids detected in any of the water or sediment samples collected from the eight sites.

Benthic Macroinvertebrates
The diversity of species found at the sites is too great to list here. A detailed list and an in-depth interpretation of the data will be included in the final report. The data has been summarized and is presented in Table 4 in biological metrics. The following is a list of the various biological metrics and their definitions:

- Taxonomic Richness - Total number of individual taxa
- Percent Dominant Taxon - Percent of organisms in sample that is the single most abundant taxon
- EPT Taxa - Number of families in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders
- EPT Index - Percent of organisms in sample that consists of Ephemeroptera, Plecoptera, and Trichoptera (EPT)
- Sensitive EPT Index - Percent of EPT in sample with tolerance values of 0 through 3
- Tolerance Value - Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)
- Intolerant Taxa - Organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0 through 2
- Tolerant Taxa - Taxon-specific organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8 through 10
- Chironomidae - Of the order Diptera (true flies) mainly consisting of midges
- Collectors - BMIs that collect or gather fine particulate matter
- Filterers - BMIs that filter fine particulate mater
- Scrapers - BMIs that graze upon periphyton
- Predators - BMIs that feed other organisms
- Shredders - BMIs that shred coarse particulate matter

Modified from Harrington and Born, 1999

In general, a healthy stream (that which is cool, clean and highly oxygenated) contains a high number of Ephemeroptera, Plecoptera, and Trichoptera. Although, two families, Baetidae (Ephemeroptera) and Hydropsychidae (Plecoptera), can dominate in moderately polluted streams, such as those with excessive nutrients or sediment (Harrington and Born, 1999). Some families of Plecoptera and Ephemeroptera can also be highly sensitive to pesticides.

The Tolerance Value reflects a community level tolerance. This metric was originally designed to serve as a measure of community tolerance to organic pollution. The regionally specific tolerance values for BMI communities in the Pacific Northwest are used here (CAMLnet, 2003). In addition, the EPA has established a list of tolerance values applicable to BMI communities in the northwestern U.S. based on their bioassessment program in Idaho. If a taxon found in California is not assigned a value in the Pacific Northwest, then this EPA value is used.
A moderately disturbed stream typically has a tolerance value in the mid-range values (Harrington and Born, 1999).

The number of Chironomid species found in most water systems usually accounts for 50% of the total BMI species richness (Merritt and Cummins, 1996). Chironomids occur in most aquatic ecosystems, tolerating a wide range of conditions (i.e. temperature, pH, salinity, oxygen concentration). They are also tolerant to water pollution, and in general their dominance at a site may indicate increased nutrients (Harrington and Born, 1999).

The Functional Feeding Groups (collectors, filterers, etc.) represent the processes or feeding habits of different macroinvertebrates in the stream. They also represent ecology production and food source availability within the stream. An imbalance of the feeding groups may reflect an unstable food process and indicate a stressed condition (Harrington and Born, 1999).

REFERENCES

Bacey, J. 2003. Instructions for sampling BMIs in wadeable waters using the multi-habitat method (Non-point source) [Online]. California Department of Pesticide Regulation. SOP No. FSWA010.00. Available at http://www.cdpr.ca.gov/docs/empm/pubs/sops/fswa010.pdf (verified 23 Feb. 2004)

Bennett, K. 1997. Conducting surface water monitoring for pesticides [Online]. California Department of Pesticide Regulation. SOP No. FSWA002.00. Available at http://www.cdpr.ca.gov/docs/empm/pubs/sops/fswa002.pdf (verified 23 Feb. 2004)

CAMLnet. 2003. List of California macroinvertebrate taxa and standard taxonomic effort [Online]. Available at http://www.dfg.ca.gov/cabw/front%20page/CAMLnetSTE.pdf (verified 23 Feb. 2004)

CVRWQCB. 2002a. Central Valley Regional Water Quality Control Board. San Joaquin River Organophosphate Pesticide Total Maximum Daily Load Bioassessment Work Plan. March 2002

CVRWQCB. 2002b. Surface Water Ambient Monitoring Program Work Plan. July 2002 [Online]. Available at http://www.swrcb.ca.gov/swamp/qapp.html (verified 23 Feb. 2004)

Harrington, J. and M. Born. 1999. Measuring the health of California streams and rivers. Sustainable Land Stewardship Int'l. Inst.

Jones, D. 1999. Transporting, packaging and shipping samples from the field to the warehouse or laboratory [Online]. Available at http://www.cdpr.ca.gov/docs/empm/pubs/sops/qaqc0401.pdf (verified 23 Feb. 2004)

Segawa, R. 1995. Chemistry laboratory quality control [Online]. Available at http://www.cdpr.ca.gov/doc/empm/pubs/sops/qaqc001.pdf (verified 23 Feb. 2004)

State Water Resources Control Board. 2001. The California streamside biosurvey. An introduction to using aquatic invertebrates as water quality indicators. September, 2001.

Tetra Tech, Inc. 2003. The Status and Future of biological assessment for California streams. Prepared for the California State Water Resources Control Board. Div. of Water Quality. January 2003.

State Water Resources Control Board. 2003. The status and future of biological assessment for California streams [Online]. Available: http://www.swrcb.ca.gov/swamp/reports.html (verified 23 Feb. 2004)

U.S. Environmental Protection Agency. 2001. Environmental monitoring and assessment program – surface waters: Western pilot study field operations manual for wadeable streams. April 2001.

Table 1. Method titles, method detection and reporting limits of OPs and herbicides

Organophosphate Pesticides in Water Method: GC/FPD		Organophosphate Pesticides Water Method: GC/FPD		Triazines/Herbicides in Method: LC/MS/MS	
Compound	**Reporting Limit (µg/L)**	**Compound**	**Reporting Limit (µg/L)**	**Compound**	**Reporting Limit (µg/L)**
Azinphos methyl	0.05	Phosmet	0.05	Atrazine	0.05
Chlorpyrifos	0.04	Thimet (Phorate)	0.05	Bromacil	0.05
Diazinon	0.04	Profenofos	0.05	Diuron	0.05
DDVP (dichlorvos)	0.05	Tribufos	0.05	Hexazinone	0.05
Dimethoate	0.05			Metribuzin	0.05
Disulfoton	0.05			Norflurazon	0.05
Ethoprop	0.05			Prometon	0.05
Fenamiphos	0.05			Prometryn	0.05
Fonofos	0.05			Simazine	0.05
Malathion	0.05			DEA	0.05
Methidathion	0.05			ACET	0.05
Methyl Parathion	0.05			DACT	0.05

Continued

Table 1. Method titles, method detection and reporting limits of pyrethroids

Pyrethroid Pesticides in Surface Water Method: GC/ECD, confirmed with GC/MSD	
Compound	**Reporting Limit (µg/L)**
Fenvalerate/Esfenvalerate	0.05
Permethrin	0.05
Bifenthrin	0.05
Lambda Cyhalothrin	0.05
Cyfluthrin	0.05
Cypermethrin	0.05
Pyrethroid Pesticides in Sediment Method: GC/ECD, confirmed with GC/MSD (MG/G)	
Compound	**Reporting Limit (µg/g)**
Fenvalerate/Esfenvalerate	0.011
Permethrin	0.01
Bifenthrin	0.01
Lambda Cyhalothrin	0.013
Cyfluthrin	0.011
Cypermethrin	0.011

Table 2. Environmental Measurements

	Fall 2002					Spring 2003				
Site	**Temp ºC**	**EC (μS/cm)**	**DO (mg/L)**	**pH**	**Physical habitat score**	**Temp**	**EC (μS/cm)**	**DO (mg/L)**	**pH**	**Physical habitat score**
Elder Creek at Elk Grove-Florin rd.	9.3	269.7	9.54	7.8	58	18.7	208.1	2.87	7.39	66
Elder Creek at Bradshaw rd.	10.4	283.2	1.78	7.4	76	14.6	266.9	0.23	8.08	91
Elk Grove Creek at Elk Grove-Florin rd.	8.7	337.8	8.01	8	72	17.6	224	0.51	8.72	65
Elk Grove Creek at Emerald Vista rd.	10.2	270.5	10.4	7.1	75	15.4	300.5	1.2	7.69	56
Little John Creek at Austin rd.	15.5	76.4	5.52	6.7	54	15.3	368.2	5.73	7.95	37
Little John Creek at Stanley rd.	19.6	124	6.21	6.6	73	19.6	286	5.67	7.76	78
Lone Tree Creek at Escalon-Belota rd.	14.9	92.1	6.58	9.48	124	13.4	113.5	8.75	7.62	124
Lone Tree Creek at Lone Tree rd.	18.4	60.1	7.31	6.56	120	14.9	84.9	8.8	7.67	93

Table 3. Pesticide Detections

Pesticide	Elder Creek		Elk Grove Creek		Little John Creek		Lone Tree Creek	
	At Bradshaw Rd.	At Elk Grove-Florin Rd.	At Emerald Vista Rd.	At Elk Grove-Florin Rd.	At Austin Rd.	At Stanley Rd.	At Escalon-Belota Rd.	At Lone Tree Rd.
Fall 2002								
Organophosphates								
Diazinon	nd	nd	trace	0.0599	nd	nd	nd	nd
Chlorpyrifos	0.0684	nd	nd	nd	nd	nd	nd	nd
Dimethoate	nd	nd	nd	nd	trace	nd	nd	nd
Triazines								
Diuron	0.174	nd	nd	nd	nd	nd	nd	0.063
Prometon	nd	nd	nd	nd	nd	nd	nd	nd
DACT	nd	nd	nd	nd	nd	nd	nd	nd
Pyrethroids								
in water	nd	nd	nd	nd	nd	nd	nd	nd
in sediment	nd	nd	nd	nd	nd	nd	nd	nd
Spring 2003								
Organophosphates								
Diazinon	nd	nd	0.14	0.212	nd	nd	nd	nd
Chlorpyrifos	0.108	trace	nd	nd	nd	nd	nd	nd
Dimethoate	nd	nd	nd	nd	nd	trace	nd	nd
Triazines								
Diuron	0.15	0.379	3.65	5.84	3.79	0.154	14.24	6.3
Prometon	nd	nd	0.133	0.131	nd	nd	nd	nd
DACT	nd	nd	nd	nd	nd	nd	0.135	nd
Pyrethroids								
in water	nd	nd	nd	nd	nd	nd	nd	nd
in sediment	nd	nd	nd	nd	nd	nd	nd	nd

*** nd = no detection   ** All detections are in µg/L (ppb).**

Table 4. Summary of Macroinvertebrates Detected – Fall 2002

Site Name:	Elder Creek		Elk Grove Creek		Little John Creek		Lone Tree Creek	
	At Bradshaw Rd.	At Elk Grove-Florin Rd.	At Emerald Vista Rd.	At Elk Grove-Florin Rd.	At Austin Rd.	At Stanley Rd.	At Escalon-Belota Rd.	At Lone Tree Rd.
Collection Method:	Multi-Habitat							
	Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Taxonomic Richness	10	30	12	10	33	34	12	23
Percent Dominant Taxon	30	48	43	45	15	24	95	75
EPT Taxa	0	1	0	0	1	2	0	2
EPT Index (%)	0	5	0	0	1	9	0	1
Sensitive EPT Index (%)	0	0	0	0	0	0	0	0
Cumulative EPT Taxa	0	1	0	0	1	2	0	2
Percent Chironomidae	65	33	62	44	57	36	1	8
Shannon Diversity	1.9	2.0	1.7	1.2	2.9	2.8	0.3	1.2
Tolerance Value	8.4	5.8	8.2	7.5	7.7	6.7	4.1	4.7
Percent Intolerant Taxa (0-2)	0	0	0	0	0	3	0	0
Percent Tolerant Taxa (8-10)	70	22	64	50	57	32	1	9
Percent Collectors	74	84	44	48	55	34	95	80
Percent Filterers	0	9	0	0	12	27	3	4
Percent Scrapers	0	2	1	1	0	1	1	5
Percent Predators	26	5	55	49	32	37	1	8
Percent Shredders	0	0	0	0	0	0	0	0
Abundance (#/ sample)	93	2405	77	173	1078	579	40196	7036

Table 4 Continued. Summary of Macroinvertebrates Detected – Spring 2003

Site Name:	**Elder Creek**		**Elk Grove Creek**		**Little John Creek**		**Lone Tree Creek**	
	At Bradshaw Rd.	**At Elk Grove-Florin Rd.**	**At Emerald Vista Rd.**	**At Elk Grove-Florin Rd.**	**At Austin Rd.**	**At Stanley Rd.**	**At Escalon-Belota Rd.**	**At Lone Tree Rd.**
Collection Method:	Multi-Habitat							
Taxonomic Richness	18	36	6	5	12	20	19	21
Percent Dominant Taxon	40	33	74	75	39	49	66	86
EPT Taxa	0	1	0	0	0	0	0	0
EPT Index (%)	0	0	0	0	0	0	0	0
Sensitive EPT Index (%)	0	0	0	0	0	0	0	0
Percent Chironomidae	64	58	98	100	83	46	16	8
Plecoptera Taxa	0	0	0	0	0	0	0	0
Trichoptera Taxa	0	0	0	0	0	0	0	0
Percent Baetidae	0	0	0	0	0	0	0	0
Percent Hydropsychidae	0	0	0	0	0	0	0	0
Shannon Diversity	2.0	2.5	1.0	0.9	1.9	1.6	1.4	0.8
Tolerance Value	7.6	6.8	6.4	9.8	7.7	5.8	5.0	5.3
Percent Intolerant Taxa (0-2)	0	0	0	0	0	0	0	0
Percent Tolerant Taxa (8-10)	70	31	11	95	51	8	14	6
Percent Collectors	91	39	89	21	73	59	93	96
Percent Filterers	2	35	0	0	26	35	6	1
Percent Scrapers	2	13	2	0	1	2	0	1
Percent Predators	3	12	9	79	0	4	1	1
Percent Shredders	1	0	0	0	0	0	0	0
Abundance (#/ sample)	721	9679	47	291	2741	2470	1772	1210

Figure 1. **Bioassessment Monitoring Sites**

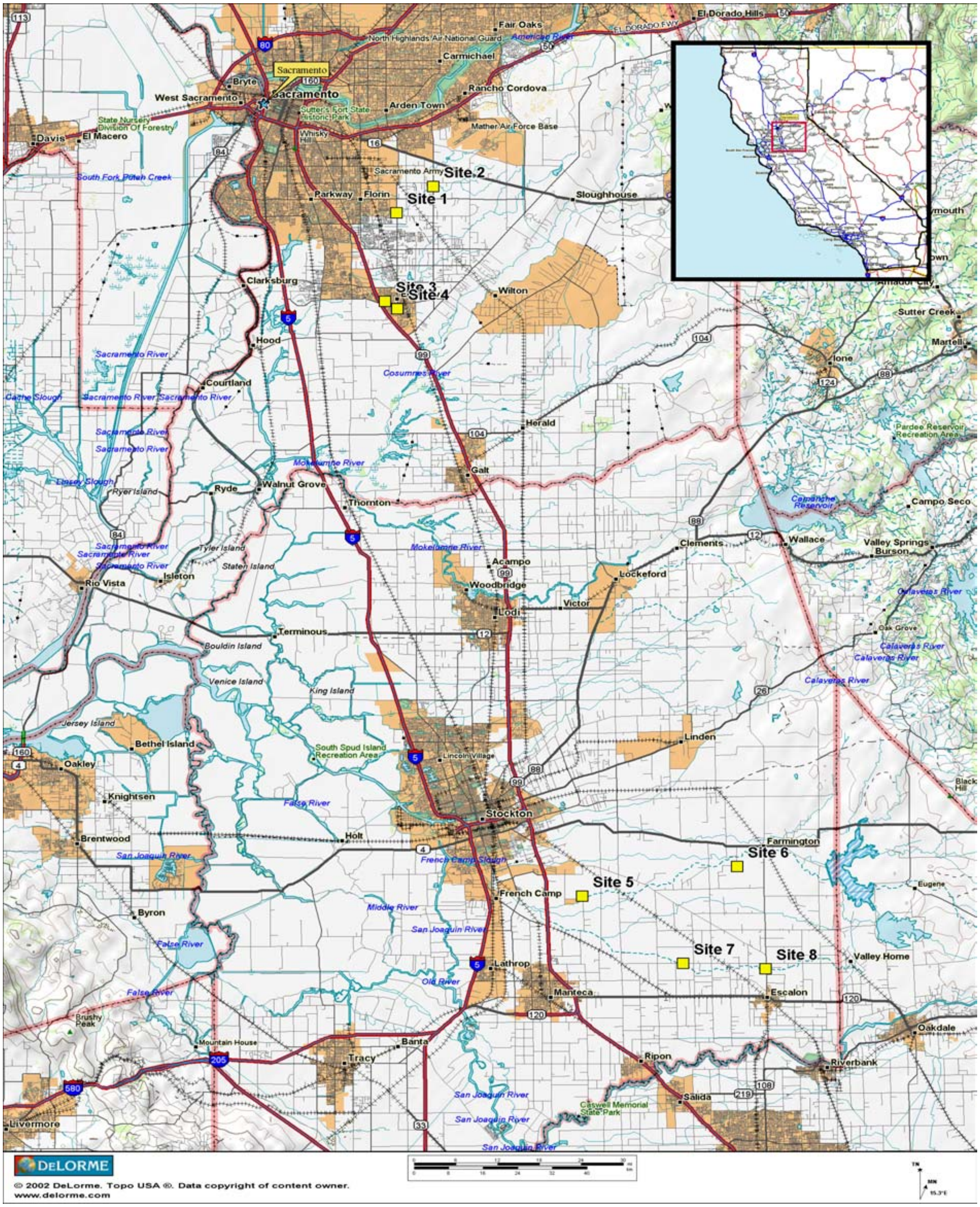

Figure 2. **Urban Sites**

Site 1. Elder creek at Elk Grove-Florin Rd.

Site 2. Elder creek at Bradshaw Rd.

Site 3. Elk Grove creek at Emerald Vista Dr.

Site 4. Elk Grove creek at Elk Grove-Florin Rd.

Figure 3. **Agriculture Sites**

Site 5. Little John creek at Austin Rd.

Site 6. Little John creek at Stanley Rd.

Site 7. Lone Tree creek at Lone Tree Rd.

Site 8. Lone Tree creek at Escalon-Belota Rd.

Figure 4.
(Side 1)

Physical Habitat Assessment Sheet

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #________ RIVERMILE________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Figure 4.
(Side 2)

Physical Habitat Assessment Worksheet

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement, over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

Figure 5. (Side 1) **Physical Characterization/Water Quality Field Data Sheet**

Study #: ___________________________ **Date/Time:**____

Sampling Crew: __________________ **Location:** ____

Weather Conditions: ____

GPS Coordinates

Lat: ________________________________

Long: ________________________________

Elevation: ________________________________

% canopy cover: ________________________________

Sample #s

OP ________

PY (water) ________

PY (sediment) ________

TR ________

BU ________

Macroinvertebrates ________

Site Information

Reach Length: ______________

Physical habitat quality score: ______________

Water Quality

Temperature ______________

EC (µS/cm) ______________

DO (mg/L) ______________

pH ______________

Nitrate ______________

Phosphate ______________

Ammonia N ______________

Alkalinity ______________

Turbidity ______________

Water Odors: (i.e. normal, fishy, sewage) ____

Water Surface Oils: (i.e. slick, sheen, globs, flecks, none) __________________________________

Turbidity: (i.e. clear, slightly turbid, turbid, opaque, stained) _______________________________

Comments:

____

____

Habitat Types (Indicates the % of each habitat type present)			
Cobble		Submerged macrophytes	
Snags		Gravel	
Sand and fine sediment		Mud	
Vegetated Banks (undercuts & overhangs)		Other	

Figure 5. (Side 2) Physical Characterization/Water Quality Field Data Sheet

Watershed features		Local watershed NPS pollution	
Forest	____	No evidence	____
Field/Pasture	____	Some potential sources	____
Agricultural	____	Obvious sources	____
Residential	____	Local watershed erosion	____
Commercial	____	None	____
Industrial	____	Moderate	____
Other	____	Heavy	____
Instream features			
Reach length	____ m	Stream depth	____ m
Stream width	____ m	Surface velocity	____ m/sec
Sampling reach area	____ m^2	(at thalweg)	____
Area in km^2 (m^2x1000)	____ km^2	(feet x 0.3048m = meters)	____
		(yards x 0.9144m = meters)	____

Aquatic vegetation (Indicate the dominant type and record the dominant species present)

Rooted emergent	____	Free floating	____
Rooted submergent	____	Floating algae	____
Rooted floating	____	Attached algae	____

Dominant species present ____

Portion of the reach with aquatic vegetation (%) ____

Inorganic substrate components (should add up to 100%)			Organic substrate components (does not necessarily add up to 100%)		
Substrate type	Diameter	% Composition in sampling reach	Substrate type	Characteristic	% Composition in sampling area
Bedrock			Detritus	Sticks, wood, coarse plant materials (CPOM)	
Boulder	>256 mm(10”)				
Cobble	64-256mm(2.5-10”)		Muck-mud	Black, very fine organic (FPOM)	
Gravel	2-64mm(0.1-2.5”)				
Sand	0.06-2mm(gritty)		Marl	Grey, shell fragments	
Silt	0.004-0.06mm				
Clay	<0.004mm (slick)				